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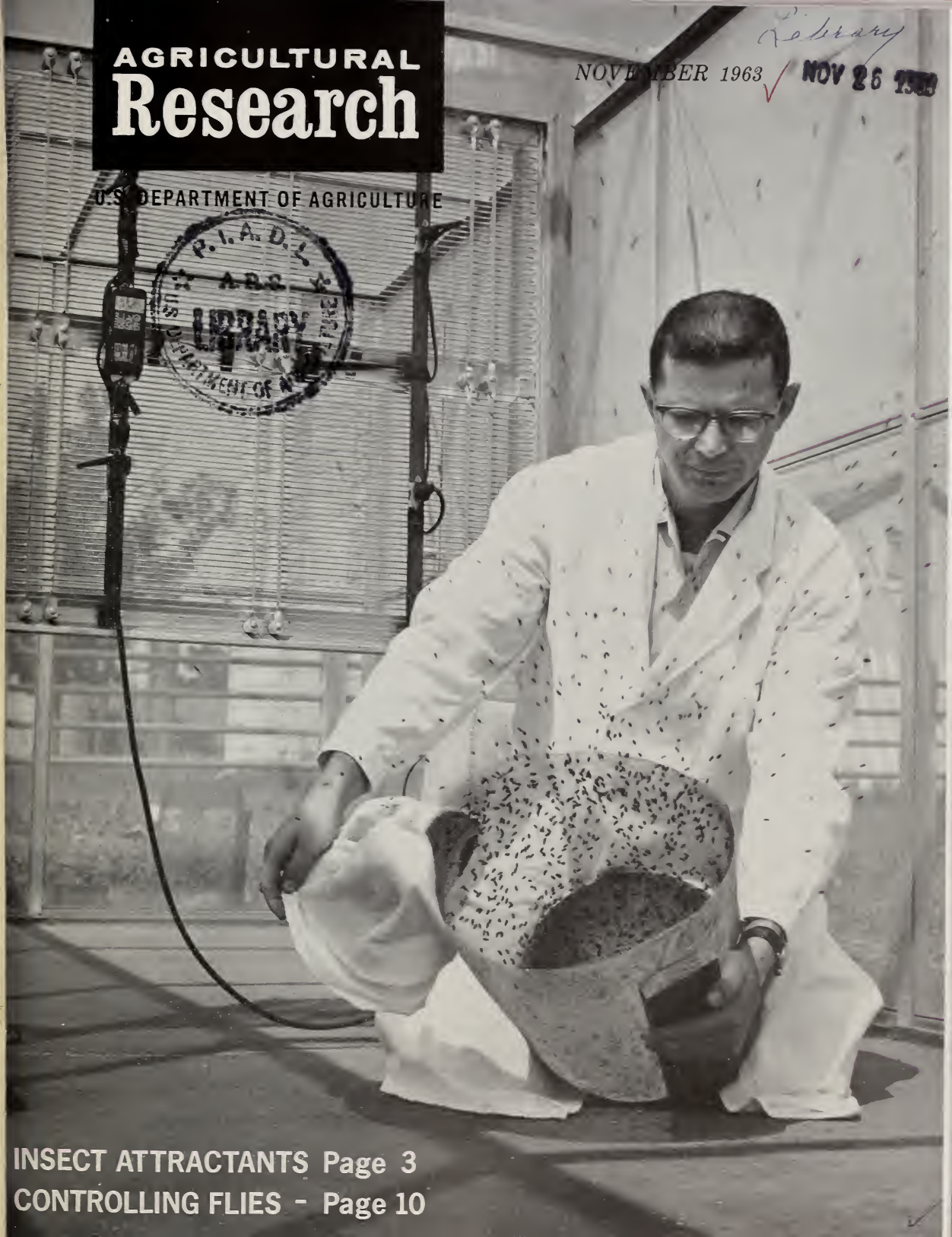

AGRICULTURAL
Research

NOVEMBER 1963/VOL. 12, NO. 5

Dividends for Consumers

Who benefits from agricultural research? Certainly the producers and processors of farm goods. But ultimately the beneficiaries are consumers, and that means all of us.

We take for granted that agricultural research has made it possible for us to have the most complete, wholesome, and economical diet in the world. But we do not expect some of the unusual dividends that have their impact in areas far removed from food. Such dividends are reported month after month on the pages of this magazine.

Here are a few examples:

A test now being used by doctors to diagnose galactosemia, a rare but severe metabolic disease in infants, was developed by ARS utilization chemists to detect ingredients in sugarbeets that hamper sugar production.

ARS scientists also discovered that measles in humans, distemper in dogs, and rinderpest in cattle are caused by related viruses—that there may be a natural cross-immunity between a boy, his dog, and his calf. Possible impact of this knowledge is being explored jointly by research veterinarians and physicians.

The aerosol can, a product of agricultural research, was developed for the military during World War II to dispense insecticides. This year a billion of these cans will be used for everything from hair spray to whipped cream.

In 1949, ARS scientists at East Lansing, Mich., discovered that poultry cancer is caused by a virus. They have since transmitted the disease to other chicks and immunized chicks against it. These studies may have far-reaching effects on research of various types of cancers, including cancer in man.

Even city land developers are benefiting from techniques based on agricultural research. They are applying soil conservation practices to large tracts of land cleared for urban homes (see page 5 of this issue) to prevent soil from being carried away to clog our rivers, hamper navigation, and spoil recreation. These same practices have long been in use on farms across the Nation.

Contents

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AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington, D.C., 20402. Printing has been approved by the Bureau of the Budget, August 15, 1958. Yearly subscription rate is $1 in the United States and countries of the Postal Union, $1.50 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C., 20402. Information in this periodical is public property and may be reprinted without permission. Mention of the source will be appreciated but is not required.

Orville L. Freeman, Secretary,
U.S. Department of Agriculture

B. T. Shaw, Administrator,
Agricultural Research Service

Besides luring insects to an insecticide, attractants are a useful survey tool to determine if the target insect is in an area. This trap is baited with methyl eugenol and naled. In Rota, these traps enabled scientists to accurately trace progress of the campaign against the oriental fruit fly and to verify its eradication.

INSECT ATTRACTANTS

A keen sense of smell may mean the downfall of many insect pests

■ Through countless centuries—estimates run as high as 400 million years—insects have waged a struggle for survival. In this long and unimaginably competitive process of natural selection, insects have developed some supersensitive faculties to guide them to food and mates. Among the most important of these faculties is olfaction—using the sense of smell to detect chemical substances that are the source of attractive odors.

Some species have a sense of smell so keen that they can detect an attractant more than a mile away. Sometimes the attractant is so strong that insects are irresistibly drawn to it.

Now, after millions of generations, this keen sense may lead an insect to its doom instead of being a vital aid to the survival of the pest.

Already, ARS and other scientists have developed several materials that attract insects. These materials were proved in 1956 and 1957, when attractants developed by ARS were combined with a pesticide to eradicate the Mediterranean fruit fly from more than 1,000 square miles in Florida.

Along with chemical attractants, ARS is studying the use of light, sound, color, air currents, and other control methods to attract and destroy insects. (See page 10 for a research report on "Controlling Flies Physically.")

In current attractant research, ARS is trying to develop specific control methods that greatly reduce or eliminate the need for insecticides and harm nothing except the target species.

The underlying advantage of this research is that attractants open the way to a multipronged attack on insect pests. Possibilities include attracting insects to traps, to lethal poisons, or to chemicals that sterilize them. Or females may be attracted to lay their eggs in places where the eggs will not hatch.

One of the most recent ARS accomplishments in attractant research was the use of the male annihilation technique to eradicate the oriental fruit fly from Rota, a Pacific island about 37 miles north of Guam. Scientists used a strong, highly specific male attractant—methyl eugenol—to lure males to an insecticide. Within 5½ months, this combination killed all males, reproduction ceased, and the species disappeared.

The Rota experiment, which culminates more than 10 years of re-

Turn Page

INSECT ATTRACTANTS *Continued*

search, is one of many projects in the ARS search for strong chemical insect attractants.

Most scientists recognize three classes of chemical insect attractants—sex, food, and ovipositional. Sex lures generally attract males, ovipositional lures generally attract females to egg-laying places, and food lures may attract either or both sexes. A material is not considered a sex lure unless attracted insects react with sexual behavior. Both ovipositional and food lures are usually associated with a food source, but scientists distinguish between them: One induces egg-laying; the other, feeding.

Exceedingly active compounds

Insect sex attractants probably are the most potent physiologically active compounds known. For example, the male American cockroach responds to about 30 molecules of the female lure, and gypsy moth males have responded from a quarter mile away.

The sex lure of some species cannot be obtained in sufficient quantity for field use unless it is synthesized, but this is not always necessary. Enough pink bollworm sex lure, for example, has been extracted directly from reared insects.

Scientists generally find it more difficult to identify the sources of food and ovipositional attractants than sources of sex attractants. Whole foodstuffs or natural materials from egg-laying sites generally lack strong and consistent attractancy. But scientists are overcoming some difficulties associated with natural whole materials with two other types of materials:

- Extracts from natural material.
- Pure chemicals.

When attractancy is found in such natural materials as plant parts or fermenting foods, scientists try to obtain a strong attractant by extracting and purifying the attractant substance and—in some cases—producing it synthetically. ARS has extracted and tested at least 1,000 compounds from natural materials.

Search is a painstaking job

The search for chemical attractants may begin on a hit-or-miss basis. Of many chemicals tested, chemists may find only one with even a weak attractancy. Starting with the weak attractant, they try to synthesize new compounds having a similar chemical structure but a stronger attractant quality. ARS scientists, the first to use a chemical-synthesis program for finding insect lures, have synthesized about 6,500 compounds for testing on 15 species.

Detecting, extracting, purifying, chemically identifying, and synthesizing chemical insect attractants involve some of the most refined and sensitive techniques known to science. Synthesis is a stiff test of a chemist's skill and imagination—differences as subtle as spatial arrangement of the atoms in a molecule can greatly change a compound's attractant qualities.

But this painstaking research is paying off. The lure for the Mediterranean fruit fly alone is worth enough to pay for all ARS attractant research many times over. Lures are also available for the oriental fruit fly, melon fly, Japanese beetle, and European chafer.

ARS accomplishments include the chemical synthesis of two strong lures for the gypsy moth. One exactly duplicates the natural lure; the other is a more easily made, closely related compound. Chemists have identified the chemical structure of the American cockroach sex attractant and are now trying to synthesize it. Substances containing the sex lure of the pink bollworm, southern armyworm, and tobacco hornworm have been extracted, and chemists are trying to isolate the sex attractants in pure form and identify them. They have extracted lures from females of the banded cucumber beetle, corn earworm, cabbage looper, and housefly.

Bright outlook for new attractants

The outlook for finding more attractants is encouraging. New techniques have recently been developed to expedite this study; many of them apply electronics to chemistry. Scientists can now turn to such tools as gas chromatography, ultraviolet and infrared light, nuclear magnetic resonance, and mass spectrometry to separate and identify the infinitesimal amounts of chemicals in insects that give off the attractant odors.☆

This article has covered just one of several new approaches being developed in ARS's broad arsenal of weapons to train on insect pests.

Another approach, employing a bacillus against the corn borer, is outlined on page 15.

Still another promising approach, the use of mass-produced viruses or "living insecticides" to control the cabbage looper and corn earworm, will be described next month.

Runoff water has gouged out tons of soil from between new homes and carried it off to clog the Anacostia River near a suburb of Washington, D.C.

Silt in Suburbia

Research-based techniques, designed for erosion control on farms, aid suburbanites

■ Conservation practices developed to restrict runoff and erosion on farmland are helping solve an urgent problem of urbanization—silt in suburbia.

Serious erosion often results from carelessness and poor planning during construction of mass housing projects and shopping centers near cities. ARS hydraulic engineer D. E. Whelan and soil scientist C. S. Britt say that as much as 121,000 tons of silt per square mile have been reported by the U.S. Geological Survey as eroding from areas in Washington, D.C., suburbs.

Metropolitan planning commissions and many Federal, State, and local agencies are concerned, because 1 million acres of agricultural land is being converted to urban use each year.

Silt from heavy erosion during construction fills stream channels, reducing their capacity to carry runoff without flooding. The silt muddies the streams, reduces the value of recreation sites, and fills navigation channels.

The scientists cite the northwest branch of the Anacostia River near Washington as an example of a stream that has been seriously damaged by silt. Flood-detention structures and extensive dredging have failed to rehabilitate the stream because urbanization of the watershed produces an estimated 1,850 tons of silt per square mile annually.

Whelan and Britt advise complete soil and water conservation planning, prior to any construction, for entire watersheds that are subject to urbanization. Similar watershed-wide conservation efforts based on ARS research and carried out under the direction of USDA's Soil Conservation Service are protecting many agricultural areas.

For urbanized watersheds, such plans should provide for safe disposal of the increased runoff from buildings, streets, and parking areas, the scientists advise. Special measures should be included for restricting erosion during construction. Temporary stilling basins that trap and hold sediment are sometimes advisable until the soil is stabilized around new construction.

The scientists say the cost of erosion control should be included in the total expense of urban development because silt control is as essential a part of urban planning as providing a community's water supply, sewage disposal, transportation, or recreation facilities.

Whelan and Britt point out that additional research is needed on the erosion hazards peculiar to urbanization. For example, methods are needed for temporarily stabilizing the subsoil where large land areas are stripped of vegetation and subjected to major regrading and reshaping.☆

This dredge boat had to rework its way under a bridge on the Anacostia River because silt had again choked the channel during the brief time the boat was dredging upstream.

Cotton roots grow laterally upon encountering compacted layer of soil.

What restricts root growth?

Soil scientists study causes—find subsoil liming would correct acidity and compaction

■ Drought damage to crops would not occur almost every year in the Southeast—where rainfall averages about 50 inches—if plants could root deeply enough to fully utilize the soil moisture.

The causes of poor root growth in the subsoil, ARS and Auburn University Agricultural Experiment Station scientists say, may be subsoil acidity, subsoil nutrient deficiency, inability of roots to penetrate a compact soil layer just below plow depth, or a combination of these conditions.

ARS soil scientist R. W. Pearson explains that most southeastern soils are acid and contain potentially toxic amounts of aluminum. In nonacid soils, aluminum is insoluble and consequently not harmful to plants. But in acid soils, the aluminum enters into solution and inhibits or prevents root growth. Present liming practices neutralize acidity in the topsoil only.

The team of scientists at Auburn found that cotton and sudangrass root growth is directly affected by aluminum toxicity in acid subsoils. Soybean roots were much more tolerant.

Manganese also enters into solution in acid soils, but the scientists report manganese toxicity does not directly affect cotton root growth. Root development continued in an acid subsoil with high manganese concentrations until—as a secondary reaction—root growth was impaired by an adverse effect on the upper plant parts.

The research also proved that cotton roots will not grow in a nonacid subsoil containing all essential elements except calcium—even though adequate calcium is supplied to the topsoil by liming. Research is continuing to determine the amount of subsoil calcium required for normal root development.

The experiments disproved the belief of some observers that the subsoil must contain available phosphorus for normal root growth. Cotton roots grew normally without available subsoil phosphorus, provided an adequate amount was supplied in the topsoil.

Role of compaction

Even though subsoil acidity or nutrient deficiency may not hinder growth of subsoil roots, plants still may be unable to force entry through the compacted layer below plow depth. All medium- and light-textured soils of the Southeast have some compaction problem if they have been cultivated. The amount of compaction depends on soil type and the extent of heavy machinery usage.

The scientists found that the strength of the compacted layer and its resistance to root penetration can be measured with a penetrometer, an instrument that records the force required to push a needle at a uniform rate into the soil. The degree of compaction preventing root entry into the layer varies with soil type.

Compaction effects in acid soils may be reduced by liming, a finding that supports results of previous studies. In the laboratory, sufficient calcium hydroxide to change Norfolk subsoil from a strongly acid to a moderately acid condition also significantly decreased soil strength and increased the number of large soil pores.

Thus, the correction of subsoil acidity could reduce compaction effects, as well as remedy failure of roots to grow in the subsoil because of toxicities and calcium shortage. Researchers are seeking a feasible method of

liming the subsoil.

The scientists have made considerable progress in their search for symptoms for diagnosing specific causes of restriction in subsoil root growth.

The elongation rate of cotton seedling roots appears to be a quick, easily measured indicator of subsoil acidity influence on root growth of cotton and other tap-rooted plants.

Aluminum toxicity seems to inhibit cell division in the region of elongation in cotton roots. By examining cell structure, the scientists determined that the nucleus of toxicity-affected root cells divided. but new cell walls failed to develop. This resulted in cells with several nuclei.

The shape of cotton root cells is affected when root growth is restricted by compaction, the scientists report. Cells in the region of elongation were long and thin in roots growing in loose soil. blocky in compacted soil where the roots penetrated with difficulty, and short and wide in soil that was so compacted the roots could not enter.

For their studies, the scientists devised a unique way of simulating, under controlled light and temperature conditions, the field situation where only the topsoil is limed to correct acidity. In one method, glass-fronted boxes were filled partly with moist subsoils of varying acidity; then a uniformly fertilized and limed topsoil was placed on the subsoil.

They planted germinated seeds in these containers and supplied adequate surface moisture until roots reached the subsoil. They then discontinued surface addition of water, forcing plants to depend upon subsoil moisture, and observed directly the response of roots to varying subsoil conditions.

Soil scientist Z. F. Lund and agricultural engineer C. R. Camp, Jr., of ARS, and Auburn soil chemist Fred Adams participated in the research with Pearson.☆

Research Tool . . .

A PILOT MODEL GIN

■ A pilot-model cotton gin that will process as little as a bushel of cotton has been developed by ARS researchers at the U.S. Cotton Ginning Research Laboratory, Leland, Miss. The gin is being used as a research tool for making improvements in ginning equipment.

A standard cotton gin requires at least 250 pounds of seed cotton for ginning tests. Comparable tests can be made on the pilot model, using only 25 pounds of cotton. This means, for example, that only one or two rows rather than a fourth of an acre of a new cotton variety would be needed for ginning tests.

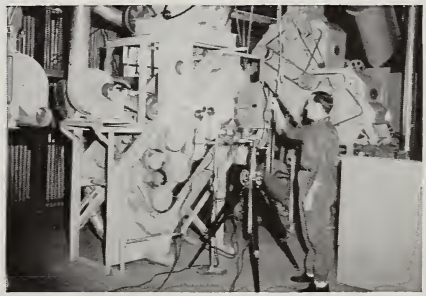
More accurate testing of gin improvements is now possible with the pilot gin because tests on several small lots of cotton give more uniform results than those on a single large lot of cotton processed in a standard gin. If cotton quality (moisture, foreign matter, etc.) is not uniform during testing, it is difficult to know if variations in ginning-test results are due to the ginning process or to the cotton.

The developers of the gin, agricultural engineer G. N. Franks and cotton technologist V. P. Moore, say the new gin eliminates the need to construct full-scale models because tests of new ginning processes will be done on the pilot model—a feature that should cut development costs considerably.

Additional savings will be realized in using the pilot gin, which can be operated at less than one-fourth the cost of a standard gin. A standard gin requires nearly 390 horsepower and eight men to operate it; the pilot gin, only 125 horsepower and six men.

An intricate system of pipes and valves in the pilot gin permits up to 27 cleaning and drying combinations. For example, seed cotton can be dried, cleaned, and ginned in that order or it can bypass the drying and cleaning operations and be piped directly to the ginning phase.

The pilot gin is the same height and length as a standard gin but is only one-twentieth the width; and whereas an average commercial gin has 360 saws, the pilot model has only 20.☆



Facing the unit's machinery with glass makes it possible to take high-speed motion pictures (shot at 8,000 frames a second) for close study of cotton being cleaned.

What Happens

When A Raindrop

■ When a raindrop strikes cultivated soil, it dislodges soil crumbs and triggers a series of processes that successively lead to rill erosion, gullying, and clogging of stream channels and reservoirs with sediment.

Basic studies by an ARS agricultural engineer are directed at understanding the mechanics of what happens when a raindrop strikes, as one phase of efforts to learn more about soil erosion.

Research has not yet progressed to a point where scientists can recommend ways to minimize the erosive force of a raindrop on bare soil. But more precise knowledge of erosion mechanics ultimately should enable scientists to devise tillage systems that more effectively restrict soil erosion on agricultural land.

Describes size, form of splash

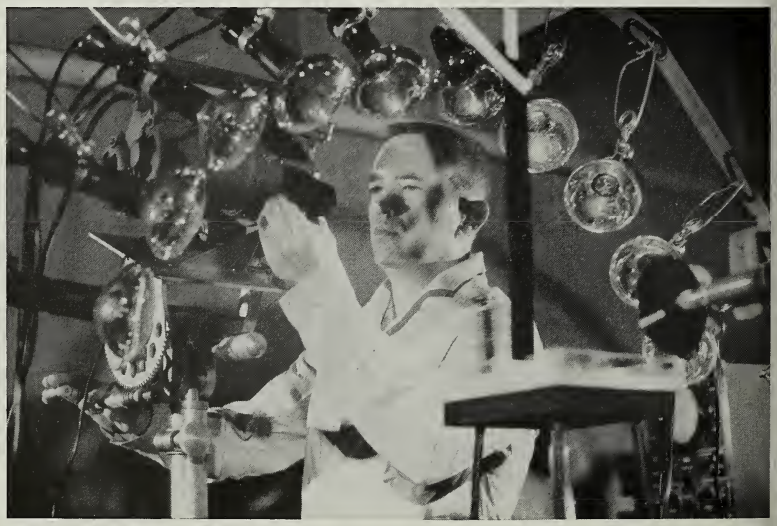
The investigations by C. K. Mutchler have revealed a way of describing the size and form of the splash pattern from a single raindrop. His research at the North Central Soil and Water Conservation Field Station, Morris, Minn., is in cooperation with the Minnesota Agricultural Experiment Station.

Mutchler is also studying the influence of raindrop size on the splash pattern and the effect that thin films of water covering the impact area have on splash shape. In nature, soil crumbs are often covered by thin water films when a raindrop strikes them.

Because the duration of the splash from a raindrop is about 40 milliseconds or less, direct measurements of splash size and shape are impossible. Instead, Mutchler takes high-speed motion pictures of various splash situations and analyzes the resulting pictures.

He forms water drops in small-bore

LEFT—In drop tower about 30 feet above impact area, engineering aide Lyle Hansen adjusts the small-bore capillary tube that forms the simulated raindrops. RIGHT—Engineer C. K. Mutchler adjusts high-speed camera to photograph raindrop splashes. Each drop triggers the battery of lights as it falls toward impact area.



Strikes

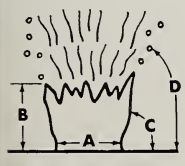
capillary tubes mounted about 30 feet (9.2 meters) above the impact point. In nature, raindrops of all sizes reach near maximum velocity of fall from this height.

Just as the drop is about to fall, the operator closes a circuit to warm up a battery of eight floodlamps focused on the impact area. The falling drop then activates relays that bring the floodlamps to full brightness and start the camera timer. Mutchler uses a 16-millimeter high-speed camera, equipped with a 50-millimeter f/2.0 lens.

Patterns projected on screen

Mutchler projects the movies on a large screen for study of splash development. He counts the number of frames (individual pictures) of movie film required to record the splash from impact to collapse and, taking film speed into account, calculates the elapsed time of the splash. He also calculates the velocity of falling drops before impact by the same method.

A significant result of Mutchler's research is a numerical description of the splash shape. He makes four measurements — splash width just above impact area (A), splash height to the point where droplets form (B), minimum angle of the sides of the splash (C), and lowest angle formed by droplets (D).



The engineer reports that the sides of a raindrop splash stand at a 90° angle with level impact surface when the splash first forms. The angle either increases or decreases (depending upon drop size and surface water depth), and then returns to 90° before the splash collapses. Most of the enlargement in splash shape takes place in the first quarter of its duration.

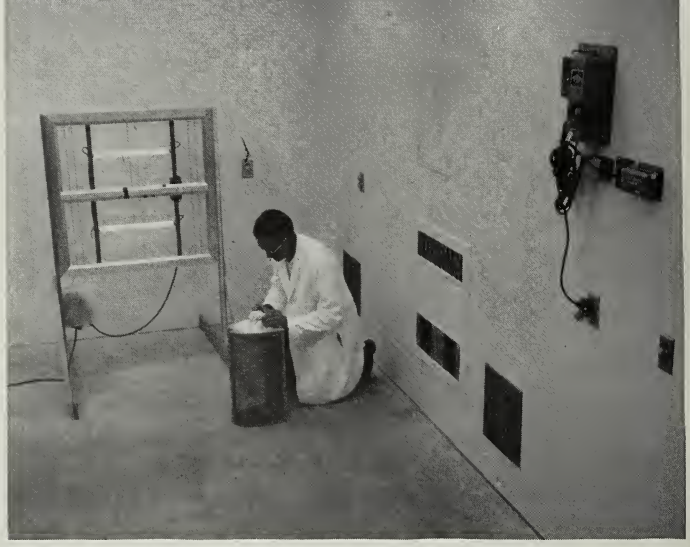
Mutchler says the larger the water drop, the higher and wider is its splash, as would be expected. The angle of the sides of the splash, however, decreases as the drop size increases.

Angle increases as water deepens

To learn the effect of the depth of water in the impact area, Mutchler studied drops 4.2 millimeters in diameter. He found that the splash angle was progressively greater as the water depth was increased. The splash angle was 53° when the water was 0.1-millimeter deep, 67° at 1.0-millimeter depth, and 78° at 90-millimeter depth.

Still to be investigated are other reasons for variation in raindrop splash, including the velocity and angle at which the drop strikes the surface, roughness or softness of the soil crumbs, movement of the water film on soil crumbs, and the turbulent effect of wind.☆

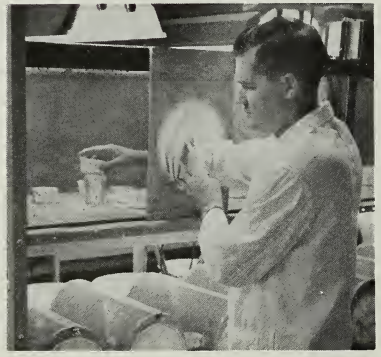
Sequence photos depict the anatomy of a raindrop's splash. In top photo, raindrop is in flight. Other photos, taken at 0.0029, 0.0058, 0.0116, and 0.0174 second after impact, show how a splash pattern develops.



LEFT—To find out what color light flies prefer, agricultural engineer W. W. Wolf helped design this chamber: Each end of the Y holds a light of different color to test its fly-attracting power. RIGHT—Promising Y-chamber leads get a larger scale trial in this room. Agricultural engineer J. G. Harsock prepares a cage of houseflies for release to test a trap whose light draws flies to their doom by electrocution.

Controlling Flies

PHYSICALLY



Entomologist R. A. Killough feeds fresh meat to flies in colony room. Houseflies, face flies, and stable flies are being reared now. Horn flies, which are reared on live animals, will be added to the program.

New laboratory investigates dramatic control methods against four types of flies

■ Four species of flies are in for some close scrutiny at a new ARS laboratory at Beltsville, Md.

Scientists there are doing basic research on the use of nonchemical methods as possible controls for houseflies, face flies, stable flies, and horn flies. The use of light as a means of attracting flies is now being investigated; research will also include studies of sound (audible and ultrasonic), radio waves, and other means for physical control of flies.

In the new laboratory, entomologists, agricultural engineers, and dairy husbandmen test their ideas first in a small room. Ideas which look promising will be tried on an expanded scale in a larger room.

Tests are also conducted outdoors in large screened cages. Eventually, the most promising tests will be verified under actual conditions.

Would eliminate residue problem

Physical control of flies is not a new idea, but very little research information is available on the subject. Physical methods—if they are effective, available at reasonable cost, and easy to use—will have an advantage over

A workshop in the new lab building enables scientists to build and repair much of their equipment. Here, engineer Wolf runs a voltage check on an electrocutor trap.

This outdoor cage is one of four (also see cover) used at Beltsville to test lab-developed methods for physical fly control. These findings will later be verified under actual conditions in a dairy barn.

chemicals because they will present no residue problem.

Although complete control by physical means is not expected in the near future, the scientists say their use as a supplementary method could reduce the amount of insecticide needed.

For example, a lamp might be used in a barn to attract flies to an insecticide placed in an area where livestock could not reach it. Another possibility is using a physical method to reduce the fly population, then applying extremely small amounts of an insecticide in "mop-up" operations.☆

MOLDING COTTON FABRICS

■ ARS scientists have developed a method for molding cotton fabrics into three-dimensional shapes. The process may mean easier fabrication of many items, including upholstery, hats, women's shoes, and brassieres.

The process is an outcome of research on stretch cottons by A. S. Cooper, Jr., A. M. Walker, and W. G. Sloan of the Southern utilization research laboratory, New Orleans. In making fabrics with more than 50-percent stretch, by a process called slack mercerization, the scientists noticed that the fabrics fitted contours well. They reasoned that if the fabric was treated with chemicals and then molded, it would retain the shape of the mold permanently.

To mold cotton fabrics, the scientists say, the fabric must first be treated with a solution of sodium hydroxide. This causes the fibers and yarns in the fabric to twist and shrink, giving the fabric stretch. The fabric is then wet with chemicals of the type used to make wash-wear cotton and then stretched over a heated mold. The heat of the mold dries the fabric and causes the chemicals to "lock" the shape into it.

There are a number of advantages to be realized through molded cotton fabrics. Molding the pointed toes of women's shoes made of stretch cotton, for example, would eliminate tiny folds and thus make the shoe more comfortable; the molding of brassiere cups would eliminate the need to sew together four triangles, thus reducing the amount of labor required. Furniture manufacturers may find molded cotton fabrics particularly helpful in speeding production and lowering the cost of furniture that requires contoured upholstery.☆

RIGHT—A. M. Walker demonstrates the making of a molded-cotton product on a heated laboratory mold.

BELOW—Molded hat is example of new line of contoured cotton fabric products made possible by process developed by ARS scientist.

NEW ANGLES ON TILING

Engineers find that lateral tile lines can join main at any angle

■ Underground drain tile lines can be laid more rapidly and at less expense if contractors follow the recommendation of ARS and Minnesota engineers when installing tile line junctions.

The lateral (or side) drainage lines should be joined to the main line at whatever angle is most convenient, since the junction angle has practically no effect on the functioning of a farm drainage system. This advice is based on research by ARS hydraulic engineer F. W. Blaisdell and P. W. Manson, agricultural engineer of the Minnesota Agricultural Experiment Station.

Findings affect other systems

The research findings may be significant in other pipe systems, too, the engineers point out. They believe the results will be useful to designers of air conditioning and oilfield collection systems and water supply and sanitary sewer systems.

Laterals are customarily joined to the main at a 45° angle.

This practice has been costly to drainage contractors. Where tile systems cannot be designed with the laterals approaching the main at 45°, the trenching machine must be halted at each junction. The crew stands idle while workmen widen the trench and lay tile by hand, curving the lateral to a 45° junction. The result may be poor workmanship and higher cost.

Research prompted by lawsuit

Manson learned, while preparing testimony as an expert witness in a lawsuit, that research did not substantiate the 45° recommendation. He and Blaisdell then began studies of drain tile junctions at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, Minneapolis.

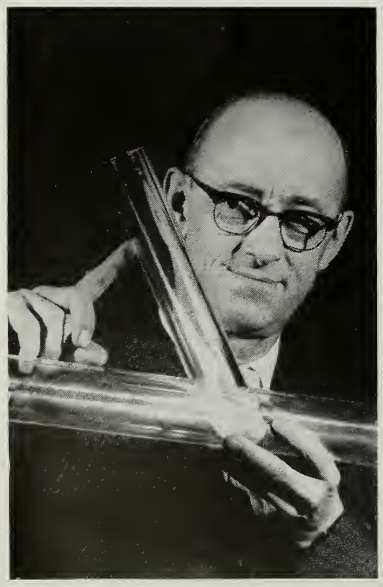
They found that the influence of junction angle on operation of most agricultural drain tile systems is so slight it can be ignored by designers and contractors.

4,500 tests with many angles

In the research, Blaisdell and Manson made some 4,500 tests with junction angles of 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, and 165 degrees. They tested the junctions under these varying conditions: Five ratios of main size to lateral size (1:1, 2:1, 4:1, 7:1, and 16:1), two positions of lateral entering main (center and off center), four waterflow velocities, and eleven variations in proportion of flow from lateral and main (ranging from entire flow in lateral to entire flow in main).

For each test, readings were taken from manometer tubes connected to pressure taps downstream and upstream of the main and lateral junction. The height of the liquid in the manometer tube—read with a precision instrument called a cathetometer—is related to the pressure at the point of measurement.

From these readings, the research engineers determined the energy that is lost due to friction at the junction. The amount of this energy that is converted to heat is not available for moving water through the tile line. With substantial energy loss, the line would flow at less than capacity, and a larger (and more expensive) tile might be needed to handle the flow. The engineers found small differences in energy loss between junction angles that need not be considered by designers of agricultural drainage systems.☆



Hydraulic engineer F. W. Blaisdell shows a plastic model of a tile junction used to study how tile junction angle affects performance of farm drainage systems.

TURF

THE RUG FOR RECREATION

■ Common bluegrass has proved to be the best of the presently available Kentucky bluegrass varieties where turf plantings are so extensive that only a minimum of management is economically possible—in parks, on athletic fields, and along highway borders.

In a 4-year study at the Agricultural Research Center, Beltsville, Md., scientists report that common bluegrass recovered more readily from disease than Merion and Newport bluegrass, even though the latter varieties produced superior turf in the first few seasons after seeding.

ARS agronomists F. V. Juska and A. A. Hanson made the study to gain additional knowledge on how to manage turf, particularly in the transitional zone of the United States (an east-west belt dividing the areas of adaptation for hot and cool weather grasses). This transitional belt, including Washington, D.C., extends southwestward from central New Jersey to northern Georgia and westward across Kentucky, southern Indiana, Illinois, and Missouri into the Southwestern United States.

Turfs compared in fourth year

Juska and Hanson found that common bluegrass outscored Merion and Newport in turf quality during the fourth growing season after fall seeding on test plots in 1958. Common had trailed Merion and Newport during the second and third growing seasons. No turf quality scores were kept during the first season.

Test plots were scored for turf quality on an arbitrary scale of 1 through 10. In 1962, common averaged 6.7 on this scale; Merion, 6.3; and Newport, 5.2. In contrast, the averages for 2 years, 1960 and 1961, were 4.0 for common, 5.0 for Newport, and 5.5 for Merion.

Grass diseases are studied

Over the 4-year period, Merion proved to be a superior bluegrass for turf, the scientists agreed. However, in the fourth growing season—starting in the spring and continuing until fall—Merion plots were heavily attacked by stripe smut, and leafspot became a secondary disease problem. Merion quality thus declined sharply in 1962 (the fourth season). Additional research is needed to determine Merion's ability to recover from stripe smut, Juska and Hanson say, for this is still a variety with a good potential for turf acreage.

Newport produced good stands of dense turf during the early seasons but became infected with fungus by the fourth. Leafspot, stripe smut, dollarspot, and rust all attacked Newport. None of the infections seemed exceptionally severe, but the combination of all four may have been responsible for the rapid decline of Newport quality in 1962. The scientists conclude that Newport is unsuited for big plantings in the transitional zone.

In their research, the scientists also analyzed the effects of cutting heights and various nitrogen fertilizer treatments on the quality of turf produced by the three varieties.

Grass mowed at a 1-inch cutting height is more susceptible to disease injury than that mowed at 2- or 3-inch cutting heights, they say, because of poorer root growth and less carbohydrate reserve storage in the plants. Common bluegrass was most affected by close mowing; Merion proved relatively tolerant because of its prostrate growth habit.

Density varied only slightly

Turf density ratings from four nitrogen treatments varied only slightly, except that the unfertilized check plots produced much sparser bluegrass than fertilized plots. The four rates at which the different plots were fertilized were—(1) 3 pounds per thousand square feet in the spring, (2) 3 pounds in the fall, (3) 3 in the spring and 3 in the fall, (4) and 1½ in the spring and 1½ in the fall.

Some relationship was noted by the scientists between the incidence of fungus disease and nitrogen fertilizer applications. Common bluegrass was more severely injured by disease at the 6-pound annual fertilizer rate than Newport, especially when mowed at the close 1-inch level. And Merion was apparently susceptible to dollarspot injury at low nitrogen application rates.☆

Home-baked or store-bought?

Specialists compare home-baked goods with commercial counterparts

■ New USDA studies provide information to help housewives choose between homemade and commercial baked products and to select the kind of product to buy—dry mix, chilled, frozen, or ready-to-serve.

In one study, ARS food scientists compared homemade and purchased products for such characteristics as tenderness and softness; in another study, economists in the Economic Research Service compared costs.

Some of the commercial products proved comparable in tenderness to homemade counterparts. Cookies baked from some mixes and refrigerated dough, for example, were more tender than the corresponding homemade products. And pancakes and waffles made from mixes were comparable in tenderness to those made from basic ingredients. But tests on baking powder biscuits, sugar cookies, piecrusts, pancakes, and waffles showed considerable variation in tenderness among the three different forms of the same foods—frozen, made from a mix, or homemade.

Both homemade and mix waffles

and pancakes were consistently more tender than the frozen ones. Frozen baking powder biscuits, however, were as tender as the homemade biscuits.

Cakes, corn muffins, and yeast rolls made from mixes were usually softer than the other products. Synthetic emulsifiers added to mixes in manufacture produce a soft crumb; such emulsifiers are not available for use in home baking.

Homemade foods yielded more

The food scientists measured yield by total weight and total volume, and also calculated the number and size of servings for each product. The homemade foods usually yielded more servings, by both volume and weight, than most of the commercial foods. Recipes for most homemade foods, unlike the unit sizes of many ready-to-serve foods, provide more than just enough servings for one meal, the scientists point out.

Commercial products generally contain less fat, protein, and energy value (calories) and more moisture and ash than the homemade counterparts. Baked products made from the mixes contained about the same amounts of calcium and phosphorus and two-thirds as much sodium and potassium, as the corresponding homemade items.

Home-baked products least costly

Cost comparisons of these foods, as determined by USDA's Economic Research Service, show that baked products from mixes were considerably less expensive than frozen and ready-to-serve items. The ready-to-serve products cost about the same per serving as the frozen products and about twice as much as the home-prepared foods. All but 8 of the 45 commercial products studied were more expensive than homemade counterparts.

Detailed information from the studies of baked products is available in two publications, "Baked Products: Consumer Quality, Composition, Yield, and Preparation Time of Various Market Forms" (Home Economics Research Report 22), and "Comparative Costs to Consumers of Convenience Foods and Prepared Foods" (Marketing Research Report 609). Single copies are available from the Office of Information, U.S. Department of Agriculture, Washington, D.C., 20250.☆

Technician tests amount of sheer force needed to break cookie. This test is a standard measure of product tenderness.

AGRISEARCH NOTES

Harvesting damp castorbeans

An ARS-engineered grain combine attachment may make it possible to harvest damp castorbean seed—an operation not possible with existing castorbean harvesting equipment.

This means castorbean growers can harvest more acres per day because they do not have to wait for the sun to dry the morning dew off the plants. And harvesting can continue in late afternoon even after moisture begins to collect once again.

Existing castorbean harvesters, which harvest the seed by shaking them off standing plants, will not harvest seed unless it is completely dry. Seed that is wet from rain, dew, or high humidity will not shake free; it must be pulled off the plant.

The attachment is added to a combine for harvesting castorbeans and removed when the combine is needed for harvesting other crops. In operation it directs the castorbean plants into the combine header. Here, the entire plant is cut and fed into the combine cylinder, where the damp seed is pulled off the plant. Seed that drops before reaching the cylinder falls on a conveyor and is carried into the combine.

The harvester is equipped with a huller mounted on top of the combine. But since castorbean seed must be completely dry to be hulled, a bypass permits seed harvested under wet conditions to go directly into the unit's storage bin for hulling after the seed has been dried. Under dry field conditions, the seed travels through the huller and then into the combine's storage bin. Hulls are blown out the rear of the machine.

The new attachment, which is still experimental, was developed by agricultural engineers L. G. Schoenleber and L. F. Bouse, who are stationed at the Oklahoma Agricultural Experiment Station, Stillwater. The harvester is now being tested for the second year in the castorbean growing areas of Nebraska and Texas.

Grain combine is equipped with attachment to "pull" damp castorbeans.

Bacillus controls corn borer

Spores of a bacterium, *Bacillus thuringiensis*, may soon be used for control of first-brood European corn borers. This bacillus proved effective in field tests last year conducted at the corn borer research laboratory, Ankeny, Iowa. If results of 1963 field tests prove successful, ARS entomologists will recommend it as one of the controls for the European corn borer next year.

The bacillus is applied on the corn as a granular material. The granules fall on the leaves and then roll into the whorl of the corn. The European corn borer eggs are laid on the leaf; after hatching, the borers ingest the bacillus and its toxic crystals while feeding in the whorl. The insect is killed by a combined process of toxic action of the crystals and active bacterial invasion.

B. thuringiensis is one of the most versatile pathogens yet found in insect research. It kills more than 110 species of destructive insects, most of which belong to the order Lepidoptera (caterpillars), yet does not harm beneficial insects or other life.

The European corn borer, one of the costliest insect pests in the United States, was accidentally imported into this country, probably on broomcorn, more than 40 years ago and now infests most of the corn-growing areas. It destroyed more than 88 million bushels of corn and cost farmers nearly $94 million in 1962.

The chief means of borer control now in use are resistant hybrids, destruction of the overwintering borer, and insecticides. Natural enemies, such as native and introduced parasites (flies and small wasps), lady

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beetles, downy woodpecker and other birds attack the borer and play a part in reducing corn borer numbers, but they cannot be depended upon to reduce borer infestations to a level that would justify omitting other controls.

ARS expands entomology lab

The ARS laboratory for study of insects affecting man and animals has moved from Orlando, Fla., to new and larger facilities on the campus of the University of Florida, Gainesville.

Since its establishment before World War II, this laboratory has been investigating the biology of household insects and those that are of medical importance to the military services—and developing methods for the control of these pests.

While at Orlando, the laboratory established an international reputation for its outstanding contributions in the field of medical entomology. DDT and insect repellants, for example, have contributed vitally to human health and welfare and are used today by civilians and governments all over the world.

The new laboratory, which has about twice the area of the one at Orlando, has facilities for controlling environment and thus permitting better rearing and testing of such insects as mosquitoes, flies, roaches, and bed bugs. There are also special units where radioactive tracers can be used to develop basic information on the mode of action in the insect of various types of control chemicals.

Present emphasis of research at Gainesville is on various ways to sexually sterilize insects by the use of gamma radiation or chemicals as a means of using the insects themselves for their own destruction.

The new laboratory will also facilitate further research on other ways to control insects, including biological methods, repellants, and attractants.

Scientists at the laboratory will continue their close cooperation and working relationships with scientists in the Department of Defense, the World Health Organization, and other national and international agencies concerned with the control of insects affecting man, particularly those insects that carry diseases.

New ARS laboratory provides twice as much area as old quarters.

Forest Service pioneers studies

The Forest Service has established two pioneering research units at its Forest Products Laboratory in Madison, Wis.

The Pioneering Research Unit in Analytical Mechanics will develop fundamental mathematical concepts that accurately describe the behavior of wood and related materials, such as plywood, under loading conditions experienced in various types of structures.

The information gained from this research can be used by other scientists and engineers in developing more efficient and economical structural designs, which, in turn, would enable wood or combinations of wood and other materials to compete more effectively in today's construction market.

The other new unit was established as the Pioneering Research Unit in Lignin Chemistry. Scientists in this unit will try to determine the basic chemical structure of lignin, a highly complex material that accounts for about a third of wood composition, and the nature of its association with other wood constituents.

U.S. GOVERNMENT PRINTING OFFICE: 1963